

WE CLAIM:

## 1. In combination,

a vacuum plasma chamber for processing a workpiece, the chamber including a reactive impedance element for electrical coupling with gas in the chamber and for connection to a first, relatively high frequency RF plasma excitation source and an electrode for carrying the workpiece and for electrical coupling with gas in the chamber and for connection to a second, relatively low frequency RF bias source; and

a filter arrangement connected to the reactive impedance element and the electrode, the filter arrangement being such that current at the second relatively low frequency flows from the electrode to the reactive impedance element without being substantially coupled to the first, relatively high frequency RF source and current at the first, relatively high frequency that flows from the first, relatively high frequency RF source is substantially prevented from flowing to the electrode and to the second, relatively low frequency RF source.

2. The combination of claim 1 wherein the filter arrangement includes: a first filter connected to the reactive impedance element for enabling current at the high frequency to flow from the first RF source to the reactive impedance element and for substantially preventing current at the low frequency from flowing from the reactive impedance element to the first RF source, and a second filter connected to the electrode for enabling current at the low frequency to flow from the second RF source to the electrode and for substantially preventing current at the high frequency from flowing to the electrode and the second, relatively low frequency RF source.

3. The combination of claim 2 wherein the first filter includes a bandpass filter connected in shunt with the reactive impedance element and having a pass band for passing current at the low frequency and substantially attenuating current at the high frequency.

4. The combination of claim 3 wherein the second filter includes a bandpass filter connected in series with the electrode and having a pass

band for passing current at the low frequency and substantially attenuating current at the high frequency.

5. The combination of claim 2 wherein the second filter includes a bandpass filter connected in series with the electrode and having a pass band for passing current at the low frequency and substantially attenuating current at the high frequency.

6. The combination of claim 1 wherein the high frequency is such as to control the density of the plasma processing the workpiece and the low frequency is such as to control the energy of ions in the plasma.

7. The combination of claim 1 wherein the reactive impedance element includes another electrode.

8. The combination of claim 1 wherein the chamber includes a wall connected to a reference potential and the reactive impedance element includes another electrode, said electrodes being included in a plasma excitation region for confining the plasma, the region having at least one side spaced from the chamber wall.

9. The combination of claim 8 wherein the plasma excitation region includes louvers connected to the reference potential and spaced from the wall, the plasma excitation region being arranged so that the gas flows into the plasma excitation region through the another electrode and out of the plasma excitation region and into other portions of the chamber between the louvers.

10. The combination of claim 9 wherein the plasma excitation region is bounded by said electrodes and louvers.

11. The combination of claim 10 wherein the plasma excitation region is symmetrical with respect to the chamber wall and a center point on the electrode for carrying the workpiece.

12. The combination of claim 11 wherein the plasma excitation region is arranged so that the spacing between said electrodes can be changed at will.

13. The combination of claim 8 wherein the plasma excitation region is arranged so that the spacing between said electrodes can be changed at will.

14. The combination of claim 8 wherein the plasma excitation region is symmetrical with respect to the chamber wall and a center point on the electrode for carrying the workpiece.

15. The combination of claim 9 wherein the plasma excitation region includes first and second surfaces at the reference potential, the first and second surfaces being respectively located between the louvers and the electrode for carrying the workpiece and the another electrode.

16. The combination of claim 15 wherein the excitation region geometry is such that different sheaths are developed between the plasma in the region and between each of (a) the electrode for carrying the workpiece, (b) the another electrode and (c) the first and second surfaces at the reference potential.

17. The combination of claim 16 wherein the excitation region geometry is such that current at the low frequency has a tendency to flow to a greater extent between the electrode for carrying the workpiece and the another electrode than from the electrode for carrying the workpiece to the surfaces of the excitation region at the reference potential.

18. The combination of claim 17 wherein the excitation region geometry is such that current at the high frequency has a tendency to flow to a greater extent between the another electrode to the surfaces of the excitation region at the reference potential than from the another electrode to the electrode for carrying the workpiece.

19. The combination of claim 16 wherein the excitation region geometry is such that current at the high frequency has a tendency to flow to a greater extent between the another electrode to the surfaces of the excitation regions at the reference potential than from the another electrode to the electrode for carrying the workpiece.

20. The combination of claim 1 wherein the combination includes a processor comprising the first and second RF sources, the first and second RF sources being respectively connected to the first and second electrodes.

21. A vacuum plasma chamber for processing a workpiece, the chamber including: a first electrode for electrical coupling with gas in the chamber and for connection to a first relatively high frequency RF source, a second electrode for carrying the workpiece and electrical coupling with gas in the chamber and for connection to a second relatively low frequency RF source, an exterior wall at a reference potential, and a plasma excitation region for confining the plasma, the region being spaced from the exterior wall.

22. The chamber of claim 21 wherein the plasma excitation region includes louvers connected to the reference potential and spaced from the wall, the plasma excitation region being arranged so that the gas flows into the plasma excitation region through the another electrode and out of the plasma excitation region between the louvers.

23. The chamber of claim 22 wherein the plasma excitation region is bounded by said electrodes and louvers.

24. The chamber of claim 22 wherein the plasma excitation region is symmetrical with respect to the chamber exterior wall and a center point on the electrode for carrying the workpiece.

25. The chamber of claim 24 wherein the plasma excitation region is arranged so that the spacing between said electrodes can be changed at will.

26. The chamber of claim 22 wherein the plasma excitation region includes first and second surfaces at the reference potential, the first surface being located between the louvers and the electrode for carrying the workpiece, the second surface being located between the louvers and the another electrode.

27. The chamber of claim 26 wherein the excitation region geometry is such that different sheaths are developed between the plasma in the excitation region and between each of (a) the electrode for carrying the workpiece, (b) the another electrode and (c) the first and second surfaces at the reference potential.

28. The chamber of claim 27 wherein the excitation region geometry is such that current at the low frequency has a tendency to flow to a greater extent between the electrode for carrying the workpiece and the another electrode than from the electrode for carrying the workpiece to the surfaces of the excitation region at the reference potential.

29. The chamber of claim 28 wherein the excitation region geometry is such that current at the high frequency has a tendency to flow to a greater extent between the another electrode to the surfaces of the excitation region at the reference potential than from the another electrode to the electrode for carrying the workpiece.

30. The chamber of claim 27 wherein the excitation region geometry is such that current at the high frequency has a tendency to flow to a greater extent between the another electrode to the surfaces of the excitation region at the reference potential than from the another electrode to the electrode for carrying the workpiece.

31. The chamber of claim 21 in combination with a processor including the first and second RF sources, the first RF source being connected to the first electrode, the second RF source being connected to the second electrode.

32. The combination of claim 31 further including a filter arrangement connected to the first and second RF sources and the first and second electrodes for: (1) enabling current from the first RF source to flow to the first electrode, (2) preventing the substantial flow of current from the first RF source to the second electrode and the second RF source, (3) enabling current from the second RF source to flow to the first and second electrodes, and (4) preventing the substantial flow of current from the second RF source to the first RF source.

33. A vacuum plasma chamber for processing a workpiece, the chamber including: a first electrode for electrical coupling with gas in the chamber and for connection to a first relatively high frequency RF source, a second electrode for carrying the workpiece and electrical coupling with gas in the chamber and for connection to a second relatively low frequency RF source, an exterior wall at a reference potential, and a plasma excitation region for confining the plasma, the plasma excitation region including louvers at the reference potential and the first and second electrodes, the louvers being spaced from the exterior wall, the plasma excitation region being arranged for enabling gas to be excited to the plasma to flow into the plasma confinement region and out of the confinement region between the louvers.

34. The chamber of claim 33 wherein the plasma excitation region is bounded by said electrodes and louvers.

35. The chamber of claim 33 wherein the plasma excitation region is symmetrical with respect to the chamber exterior wall and a center point on the electrode for carrying the workpiece.

36. The chamber of claim 35 wherein the plasma excitation region is arranged so that the spacing between said electrodes can be changed at will.

37. The chamber of claim 33 wherein the plasma excitation region



includes first and second surfaces at the reference potential, the first surface being located between the louvers and the electrode for carrying the workpiece, the second surface being located between the louvers and the another electrode.

38. The chamber of claim 37 wherein the excitation region geometry is such that different sheaths are developed between the plasma in the excitation region and between each of (a) the electrode for carrying the workpiece, (b) the another electrode and (c) the first and second surfaces at the reference potential.

39. The chamber of claim 38 wherein the excitation region geometry is such that current at the low frequency has a tendency to flow to a greater extent between the electrode for carrying the workpiece and the another electrode than from the electrode for carrying the workpiece to the surfaces of the excitation region at the reference potential.

40. The chamber of claim 39 wherein the excitation region geometry is such that current at the high frequency has a tendency to flow to a greater extent between the another electrode to the surfaces of the excitation region at the reference potential than from the another electrode to the electrode for carrying the workpiece.

41. The chamber of claim 38 wherein the excitation region geometry is such that current at the high frequency has a tendency to flow to a greater extent between the another electrode to the surfaces of the excitation region at the reference potential than from the another electrode to the electrode for carrying the workpiece.

42. The chamber of claim 33 in combination with a processor including the first and second RF sources, the first RF source being connected to the first electrode, the second RF source being connected to the second electrode.

43. The combination of claim 42 further including a filter

arrangement connected to the first and second RF sources and the first and second electrodes for: (1) enabling current from the first RF source to flow to the first electrode, (2) preventing the substantial flow of current from the first RF source to the second electrode and the second RF source, (3) enabling current from the second RF source to flow to the first and second electrodes, and (4) preventing the substantial flow of current from the second RF source to the first RF source.

44. A vacuum plasma chamber for processing a workpiece, the chamber including: a first electrode for electrical coupling with gas in the chamber and for connection to a first relatively high frequency RF source, a second electrode for carrying the workpiece and electrical coupling with gas in the chamber and for connection to a second relatively low frequency RF source, and a third electrode connected to a reference potential inside a plasma excitation region.

45. The chamber of claim 44 wherein the excitation region and a chamber wall are substantially isolated from each other by a plasma confinement arrangement.

46. The chamber of claim 45 wherein the confinement arrangement includes an arrangement for passing the gas from inside the excitation region to outside the excitation region and for affecting the gas pressure in the region.

47. The chamber of claim 44 wherein the excitation region includes a louver arrangement for substantially confining the plasma to the region.

48. The chamber of claim 47 wherein louvers of the louver arrangement have high electrical conductivity and are at the reference potential.

49. The chamber of claim 47 wherein louvers of the louver arrangement have low electrical conductivity and float electrically and are arranged to mechanically confine the plasma.



50. The chamber of claim 49 wherein the spacing between adjacent pairs of the louvers is such as to provide the mechanical confinement.

51. The chamber of claim 50 wherein the spacing is adjustable.